CHAPTER 3
AFFECTED ENVIRONMENT

This chapter describes relevant existing environmental conditions for resources potentially affected by the proposed action and ocean test site. In compliance with guidelines contained in NEPA, CEQ regulations, and the Department of the Navy (DoN) procedures for implementing NEPA, the description of the affected environment focuses only on those aspects potentially subject to impacts.

3.1 AIR QUALITY

3.1.1 Applicable Regulations, Plans and Policies

The Federal Clean Air Act (42 U.S.C. 7401) requires the adoption of National Ambient Air Quality Standards (NAAQS) to protect the public health, safety and welfare from known or anticipated effects of air pollution. The NAAQS have been updated occasionally. Current standards are set for nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), particulate matter less than 10 microns (PM_{10}), fine particulate matter less than 2.5 microns ($PM_{2.5}$) and lead (Pb). Standards for 8-hour ozone and $PM_{2.5}$ became effective on September 15, 1997 and policies and systems to implement these new standards are being developed. No new controls with respect to the new standards will be required until after the year 2002. The State of California Air Resources Board (ARB) has established additional standards which are generally more restrictive than the NAAQS. Federal and state standards are shown in Table 3-1.

In San Diego County, the San Diego Air Pollution Control District (SDAPCD) is the agency responsible for protecting the public health and welfare through the administration of federal and state air quality laws and policies. Included in the SDAPCD's tasks are the monitoring of air pollution, the preparation of the State Implementation Plan (SIP) and the promulgation of Rules and Regulations. The SIP includes strategies and tactics to be used to attain acceptable air quality in the County. The elements are taken from the Regional Air Quality Strategies (RAQS) which is the SDAPCD plan for attaining the state ozone standard. The state standard requires cleaner air than the federal standard. The Rules and Regulations include permitting procedures, emissions limitations and analysis and reporting requirements necessary to implement the SIP and RAQS, and to prevent adverse impacts.

3.1.2 Compliance with Air Quality Standards

Specific geographic areas are classified as either "attainment" or "nonattainment" areas for each pollutant based upon the comparison of measured data with NAAQS and state standards. The San Diego Air Basin (SDAB), which is contiguous with San Diego County, currently meets the federal standards for all pollutants except ozone, and state standards for all pollutants except ozone and PM_{10}. Therefore, the SDAB is currently classified as a federal and state "serious" ozone nonattainment area and a state nonattainment area for $PM_{10.}$ The SDAB is a federal "maintenance area" for CO, following a 1998 redesignation as a CO attainment area.

The proposed ocean test site is located entirely outside the San Diego Air Pollution Control District (SDAPCD). The federal and state attainment status of the SDAPCD is identified in Table 3-2.

Table 3-1. California and National Ambient Air Quality Standards

POLLUTANT	AVERAGING TIME	CALIFORNIA STANDARDS (1)		NATIONAL STANDARDS (2)		
		Concentration	Method	Primary	Secondary	Method
Ozone (3)	1 Hour	0.09 ppm (180 $\mu g/m^3$)	Ultraviolet Photometry	0.12 ppm (235 $\mu g/m^3$)	Same as Primary Standards	Ethylene Chemiluminescence
Carbon Monoxide	8 Hour	9.0 ppm (10 mg/m^3)	Nondispersive Infared Spectroscopy	9.0 ppm (10 mg/m^3)	Same as Primary Standards	Nondispersive Infared Spectroscopy
	1 Hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
Nitrogen Dioxide	Annual Average		Gas Phase Chemiluminescence	0.053 ppm (100 $\mu g/m^3$)	Same as Primary Standards	Gas Phase Chemiluminescence
	1 Hour	0.25 ppm (470 $\mu g/m^3$)				
Sulfur Dioxide	Annual Arithmetic Mean		Ultraviolet Fluorescence	0.03 ppm (80 $\mu g/m^3$)		Pararosaniline
	24 Hour	0.04 ppm (105 $\mu g/m^3$)		0.14 ppm (365 $\mu g/m^3$)		
	3 Hour				0.50 ppm (1300 $\mu g/m^3$)	
	1 Hour	0.25 ppm (655 $\mu g/m^3$)				
Suspended Particulate Matter (PM-10)	Annual Arithmetic Mean	30 $\mu g/m^3$	Size Selective Inlet High Volume Sampler and Gravimetric Analysis	50 $\mu g/m^3$	Same as Primary Standards	Inertial Separation and Gravimetric Analysis
	24 Hour	50 $\mu g/m^3$		150 $\mu g/m^3$		
Fine Particulate Matter (PM-2.5)	Annual Arithmetic Mean	-	-	15 $\mu g/m^3$	Same as Primary Standards	Inertial Separation and Gravimetric Analysis
	24 Hour	-		65 $\mu g/m^3$		
Sulfates	24 Hour	25 $\mu g/m^3$	Turbidimetric Barium Sulfate			
Lead	30 Day Average	1.5 $\mu g/m^3$	Atomic Absorption			Atomic Absorption
	Calendar Quarter			1.5 $\mu g/m^3$	Same as Primary Standards	
Hydrogen Sulfide	1 Hour	0.03 ppm (42 $\mu g/m^3$)	Cadmium Hydroxide Stractin			
Vinyl Chloride (chloroethene)	24 Hour	0.010 ppm (26 $\mu g/m^3$)	Tedlar Bag Collection, Gas Chromatography			
Visibility Reducing Particles	8 Hour (10:00 a.m. to 6:00 p.m. PST)	Insufficient amount to produce an extinction coefficient of 0.23 per kilometer due to particles when the relative humidity is less than 70 percent. Measurement in accordance with AHB Method V				

Ppm = parts per million
g/m^3 = micrograms per cubic meter
mg/m^3 = milligrams per cubic meter

(1) CO, SO_2 (1 Hour), NO_2, O_3, PM-10 and Visibility Reducing Particulates Standards are not to be exceeded. All other California Standards are not to be equalled or exeeded.
(2) Not to be exceeded more than once a year except for annual standards: new ozone standard can be exceeded three times per year.
(3) USEPA has recently revised the ozone standard. The new averaging time is 9 hours and the Primary Standard is 0.09 ppm. Attainment status will be determined in the year 2000.

Sources: California Air Resources Board 1998: USEPA 1998

Table 3-2. Federal and State Attainment Status for San Diego Air Pollution Control District

	NAAQS	CAAQS
SDAPCD		
O3	Serious nonattainment	Nonattainment
NO2	Attainment	Attainment
SO2	Attainment	Attainment
CO	Maintenance	Attainment
PM10	Attainment	Nonattainment
Pb	Attainment	Attainment

3.1.3 Sensitive Receptors

Sensitive receptors are those populations that are more susceptible to the effects of air pollution than the population at large. Sensitive receptors who are in proximity to localized sources of toxics and CO are of particular concern. Land uses considered to be sensitive receptors include long-term health care facilities, rehabilitation centers, convalescent centers, retirement homes, residences, schools, playgrounds, child care centers and athletic facilities. There are no sensitive receptors in the vicinity of the proposed test. The test area is a marine environment offshore of MCB Camp Pendleton.

3.1.4 Clean Air Act Conformity

The Clean Air Act Amendments of 1990 (Pub. L. 101-549, 104 Stat. 2399) require the USEPA to promulgate rules to ensure that federal actions conform to the appropriate SIP. These rules, known together as the General Conformity Rule (40 C.F.R 51.850-860 and 40 C.F.R. 93.150-160), require any federal agency responsible for an action to determine if its action conforms with pertinent guidelines and regulations. Federal actions may be exempt from a conformity determination if the projected emission rates would be less than specified emission rate thresholds, known as "*de minimis* limits", and less than 10 percent of the area's annual emission budget. The General Conformity Rule also exempts specified actions "which would result in no emissions increase or an increase in emissions that is clearly *de minimis*", actions "where the emissions are not reasonably foreseeable" and actions "…which implement a decision to conduct or carry out a conforming program…."

3.2 MARINE ENVIRONMENT

3.2.1 Background

The marine environment can be described in terms of physical and chemical marine water characteristics, including physical oceanography and marine sediments and bathymetry. A general description of the marine environment along the West Coast of the CONUS and site-specific information for the ocean test site is provided in this section. The proposed ocean test location is offshore of the MCB Camp Pendleton in an area referred to as the Southern California Bight (SCB) (refer to Figure 2-4).

3.2.2 PSS Ocean Test Locations

3.2.2.1 Proposed PSS Ocean Test Location

Physical Oceanography

The dominant hydrographic feature along the California coast is the California current, which controls the general water characteristics and circulation of the area. The California current originates in colder northern waters and flows southward along the West Coast of North America. The California Current within the SCB is part of a large semipermanent eddy called the Southern California eddy. Beneath the California current (at a depth of approximately 500 m [1,640 ft]), the California undercurrent flows in a northerly direction. This current system manifests three seasonal current patterns:

- From December to February, the California undercurrent becomes stronger and partially displaces the California current westward. The Southern California eddy is weak.

- From March to June, along-shore winds strengthen and drive surface waters offshore. At deeper layers, cold nutrient-rich water flows toward the shore and rises to compensate for the displaced surface water. This is a coastal event that may be more intense in certain locations depending on bottom topography and current strength.

- From July to November, the southward flowing California current dominates the nearshore current patterns, and the Southern California eddy is well developed (Hickey 1993).

Water Quality

The State Water Resources Control Board (SWRCB) adopted the Water Quality Control Plan for ocean waters of California in 1974; amendments were made to the plan in 1988, 1990, and 1997 (SWRCB and California EPA 1997). Ocean water quality is generally high, and meets criteria set forth by the Ocean Plan and/or National Ambient Water Quality Criteria (USEPA 1986). The amended plan (The Ocean Plan) establishes beneficial uses and water quality objectives for waters of the Pacific Ocean adjacent to the California coast outside of enclosed bays, estuaries, and coastal lagoons. The Ocean Plan identifies effluent quality requirements and management principles for waste dischargers and specific waste discharge prohibitions. It also contains a prohibition against discharge of specific hazardous substances and sludge, bypass of untreated waste, and discharges that impact Areas of Special Biological Significance (ASBS). However, the SWRCB may grant exceptions to allow a discharge into an ASBS provided the exception will not compromise protection of ocean waters for beneficial uses and the public interest will be served (California Regional Water Quality Control Board [CRWQCB] 1994).

Marine Water Characteristics

Surface water temperatures along the coast of Southern California can show seasonal variation in association with upwelling, climatic conditions, and latitude. Surface water temperatures in the SCB normally range between 12°C (54°F) in the winter to 19°C (66°F) in the summer, with maximum variations between 10°C (50°F) and 23°C (73°F) (USEPA 1988a,b).

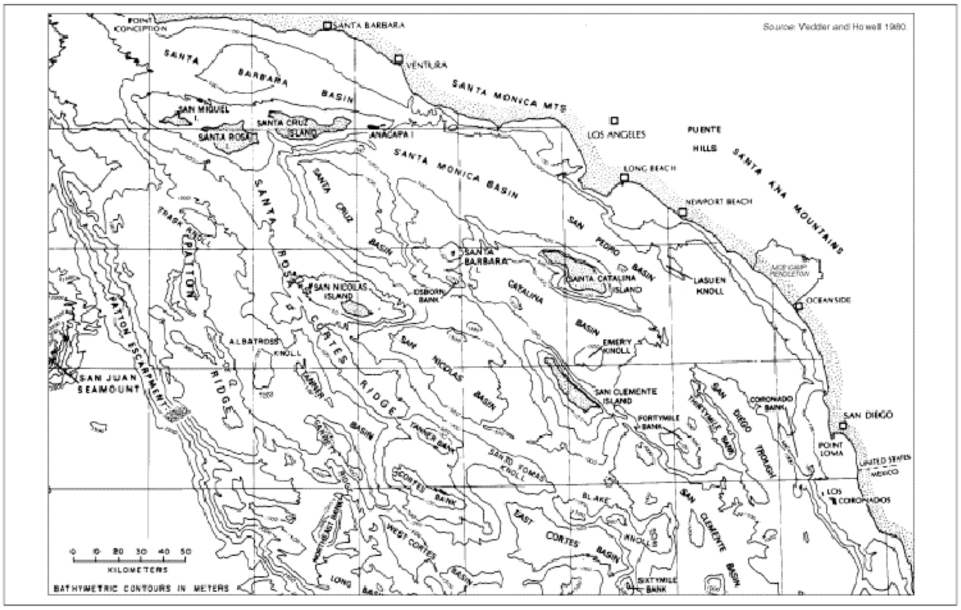

Figure 3-1. Bathymetry of the Southern California Bight

Salinity levels in the SCB are relatively constant with slight seasonal variations. Variations in salinity measurements are generally small, ranging between 32.9 and 34.5 parts per thousand (ppt). Minimum and maximum salinities typically occur in December and May, respectively (Allan Hancock Foundation 1965).

Marine Sediments and Bathymetry

An important feature of the SCB is the accentuated bottom relief and varied bottom substrate. The ocean floor off San Diego has a complex topography and does not have a continuously deepening slope from shore to the deep basin of the San Diego trough (1,100-m 3,600-ft]). Instead, a portion of the intervening ocean floor rises 120 m (390 ft) to form the Coronado bank. On the western side of the Coronado bank, the Coronado escarpment descends steeply into the San Diego trough. On the southern side of the Coronado bank is a steep submarine canyon, the Coronado Canyon (U.S. Department of Commerce 1980).

Characteristics of bottom sediments in the SCB are influenced by local submarine features and oceanographic conditions. The finer sediment fractions of silt and clay are common in the deeper portions of the bight, while at intermediate depths roughly equal proportions of sand and fine sediment are typically found. In shallower waters, coarser sand fractions increase (USEPA 1988a,b).

3.3 MARINE BIOLOGY

3.3.1 Background

The following section describes marine biology for the proposed ocean test site. This includes a general description of the habitat types and associated marine biology along the West Coast of CONUS as well as site-specific information for the ocean test location. Marine mammals and terrestrial biology are discussed separately in Sections 3.4 and 3.5, respectively. Territorial waters are defined as the waters extending up to 12nm from land.

3.3.2 PSS Ocean Test Locations

3.3.2.1 Proposed PSS Ocean Test Location

Marine Flora

The diverse assemblage of marine plants within the proposed ocean test area ranges in size from microscopic one-celled organisms living in bottom sediments or drifting with currents, to large, canopy-forming kelps. The majority of marine plants exist in the photic zone of the ocean (the area where light penetrates the water). In general, proportionally fewer creatures are found at greater depths or distances from land.

Approximately 280 species of phytoplankton and 669 species of macroalgae are known to occur in California waters (Abbott and Hollenberg 1976). The mixing of waters from northern and southern currents influences the species diversity and abundance of small planktonic organisms in the SCB. Plankton productivity is generally highest during the summer (July to September) and lowest during the winter months (October to December) (USEPA 1988a,b).

Larger marine plants fall into two main groups: grasses and algae. Seagrasses include eelgrass *(Zostera marina),* which inhabits muddy substrates in bays, and surfgrass *(Phyllospadix* spp.), which is found on exposed rocky shores. Algae can range in size from microscopic, one-celled organisms to kelp forests more than 30 m (100 ft) in length. Several species of kelp occur throughout the SCB, generally in nearshore areas at water depths between 1 and 30 m (3 and 100 ft). All require hard substrate (e.g., sandstone or rock) for attachment and growth. The most visible kelp is the giant kelp *(Macrocystis pyrifera),* which can form large beds or canopies at the surface. Giant kelp can experience tremendous growth during the spring and summer months (up to 0.5 m [1.5 ft] per day), but can experience high mortality from wave action during winter storms (Foster and Schiel 1985). Other kelps include *Egregia menziesii*, *Eisenia arboreal Cystoseira osmundacea*, *Pterygophora californica*, *Pelagophycus porra*, *and Laminaria* spp., which are generally found in the understory of giant kelp forests or in similar habitats. Physical (e.g., temperature, light, sedimentation) and biological factors (e.g., grazing, competition with other species) can affect the distribution and abundance of kelp.

Kelp beds have historically been present in the central and northern portions of the area (Figure 3-2). The proposed site area is generally dominated by a sandy bottom separated by numerous and extensive sandstone/cobble reefs that do not support kelp but support commercially important invertebrates and fishes. Also present are three California Department of Fish and Game (CDFG) artificial reefs. The northernmost reef was constructed in 1980 and covers approximately 3.5 acres (1.4 hectares [ha]). Two other artificial reefs are located offshore of Oceanside Harbor (Figure 3-2). The southernmost reef was

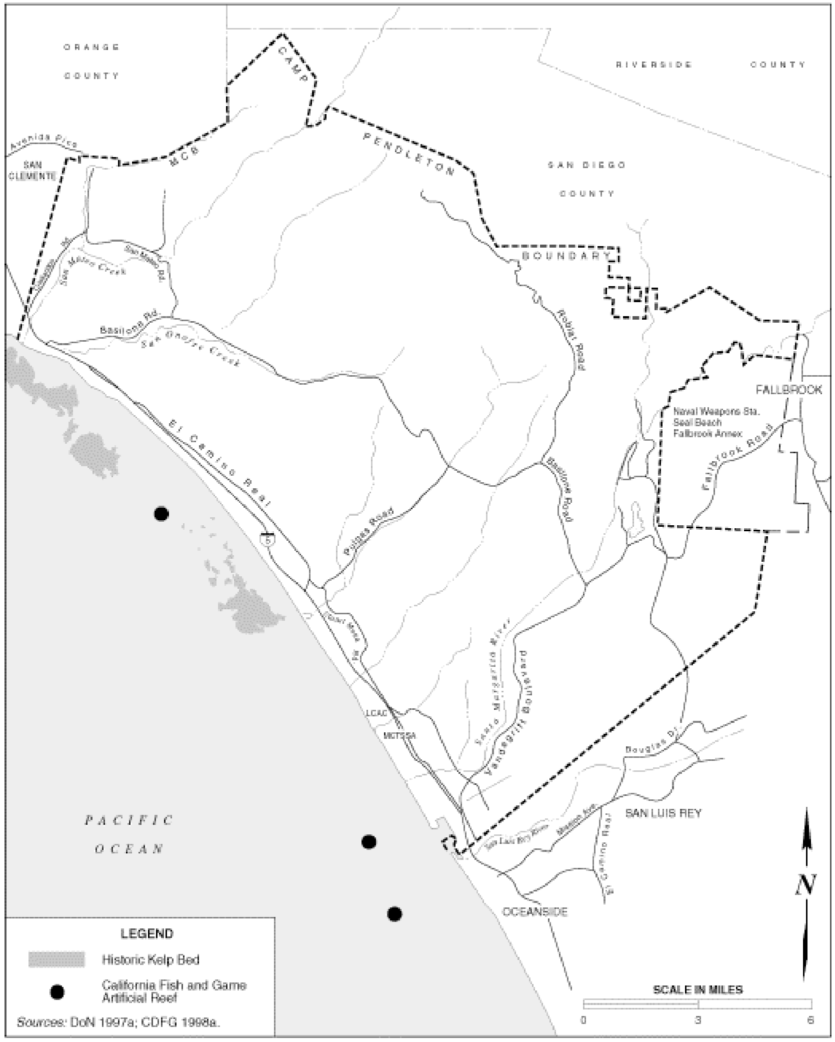

Figure 3-2. MCB Camp Pendleton Historic Kelp Beds and Location of California Department of Fish and Game Artificial Reefs

constructed in 1964 and covers an area of approximately 4 acres (1.6 ha), while the last reef was constructed in 1987 and covers approximately 256 acres (104 ha). These reefs are composed of modules that are piles of quarry rock, stacked approximately 2-4 m (6-13 ft) high. The modules vary in size, but can be as long as 17 m (56 ft). Although the artificial reefs do not support kelp, they do provide habitat for lobster and commercially and recreationally important fish.

Marine Fauna

Marine animals can be grouped into three general categories based on where they live and their form of movement: planktonic, nectonic, and benthic. Planktonic animals (zooplankton) drift with the ocean currents and are unable to determine their horizontal position within the ocean. Zooplankton are present in the water column from the air-sea interface to the ocean bottom (Tait 1980).

Nectonic organisms have the ability to swim and move independent of ocean currents. This group includes animals such as fish, squid, marine reptiles, and marine mammals (refer to Section 3.4 for a detailed discussion of marine mammals). About 481 species of fish inhabit the SCB (Cross and Allen 1993). The great diversity of species in the area occurs for several reasons: (1) the ranges of many temperate and tropical species extend into and terminate in the SCB; (2) the complex bottom topography and complex physical oceanographic regime includes several water masses and a changeable marine climate (Hom and Allen 1978; Cross and Allen 1993); and (3) the islands and nearshore areas provide a diversity of habitats that include soft bottom; rock reefs; extensive kelp beds; and estuaries, bays, and lagoons.

Northern species tend to move into deep, colder water or upwelling areas. There are also seasonal migrations of temperate and subtropical species into the SCB and invasions of tropical species during warm-water years and northern species during cold water years (Cross and Allen 1993).

The most abundant commercially fished species in the SCB are Pacific sardine *(Sardinops sagax caeraleus)*, Pacific mackerel *(Scomber japonicus)*, jackmackerel *(Trachurus symmetricus)*, skipjack tuna *(Katsuwonus pelamis)*, northern anchovy *(Engraulis mordax)*, Pacific bonito *(Sardo chiliensis)*, thresher shark *(Alopias volpinus)*, Dover sole *(Microstomus pacificus)*, California halibut *(Paralichthys californicus)*, and rockfish *(Sebastes spp.)*.

Point Conception is recognized as a boundary for certain fish species. South of Point Conception, Benthic organisms are separated into two groups based on where they reside. Infauna are organisms such as worms, mollusks, and crustaceans that live buried in ocean sediments. Epifauna are organisms that live and move over the surface of the ocean bottom. Many species occupy the bottom sediments of the Pacific coast; however, polychaete worms and bivalve mollusks are the most common benthic species in sandy sediments. Common epifauna include echinoderms, crustaceans, and demersal fish.

Several clam species are common or abundant throughout the SCB on the nearshore continental shelf. Abundant clams include species of the genera *Tellina*, *Macoma*, *and Spisula.* Sand dollars and tubicolous polychaetes of the genera Diopatra, Nothria, Onuphis, Owenia, and Pista frequently dominate assemblages on the shallower portions of the shelf. In mid-depth portions of the shelf, patches of the geoduck *(Panopea generosa)* are common. In deeper portions of the shelf, deposit feeders are more common. These include tubicolous polychaetes such as maldanids, the burrowing echlurold *(Listriolobus pelodes)*, sea cucumbers, and several species of small deposit-feeding bivalves. The small clam *(Cardita ventricosa)* is one of the more common clams in deeper portions of the shelf (Jones 1969). In addition, numerous predatory and opportunistic invertebrates (i.e., scavengers) are common in these assemblages (e.g., various crabs, hermit crabs, starfish, and snails).

Nearshore Habitats

When compared with other nearshore habitats, the diversity of organisms found on sandy bottom habitats in the SCB is relatively low. Some of the more common organisms include sand crabs *(Emerita, Blepharipoda)*, polychaete worms *(Nephtys)*, clams *(Macoma, Tivela)*, surf perch *(Amphistichus)*, and halibut *(Paralichthys)*. The subtidal zone of sandy bottom habitats is more stable than the intertidal zone; common organisms include sand dollars *(Dendraster)*, various polychaete worms *(Pista, Diopatra), and* snails *(Natica, Polinices, and Olivella).*
Estuaries and lagoons are partially enclosed coastal embayments where fresh and sea water meet and mix. The dynamic fluctuations of the physical and chemical regimes often create a stressful environment for organisms. Most estuaries are dominated by muddy substrates. Some common

estuarine flora include *Ulva, Enteromorpha, and Salicornia,* while common fauna include clams *(Tresus),* crabs, polychaete worms, fishes (perch, flatfish), sharks *(Triakis),* and rays *(Myliobatus).*

Estuaries can also serve as a transitional habitat. This includes those organisms that pass through the estuary on their way to breeding grounds (e.g., migratory fish such as salmon).

Threatened and Endangered Species

The U.S. Fish and Wildlife Service (USFWS) list the tidewater goby (Eucyclogobius newberry) as an endangered species. Its range includes the SCB where it inhabits coastal lagoons and shallow areas of bays (Miller and Lea 1972; Eschmeyer and Herald 1982). In addition, the Southern California Evolutionary Significant Unit (ESU) of westcoast steelhead *(Oncorhynchus mykiss)* was recently listed by the USFWS as endangered (USFWS 1996). Although steelhead is a migratory species that return to their natal stream, they typically spend 2-3 years in marine waters.

Four species of sea turtles found in Southern California waters are currently listed as either endangered or threatened under the Endangered Species Act (ESA) of 1973 as amended (National Marine Fisheries Service [NMFS] and USFWS 1995). These include loggerhead *(Caretta caretta), leatherback (Dermochelys coriacea),* eastern Pacific green *(Chelonia mydas),* and olive ridley *(Lepidochelys olivacea).* However, none of these four species is known to nest on beaches in Southern California. Threatened and endangered marine mammals are addressed separately in Section 3.4.

Little specific data are available on the use of the SCB by sea turtles, and no data is available on actual numbers of turtles occurring there. Sea turtles may be encountered year-round in the SCB with the highest concentrations during the warmer summer months (July-September) and during abnormally warm water years (e.g., El Nino years). Only three species of sea turtles are likely to be encountered in the SCB: juvenile loggerhead, leatherback, and green. Olive ridley turtles are present but rarely encountered north of Baja California, Mexico (NMFS and USFWS 1998a).

Although the green sea turtle is the most commonly sighted hard-shelled sea turtle along the U.S. Pacific coast, it is still uncommon and sightings are probably vagrants from, or migrants to, breeding areas in Baja California, Mexico (NMFS and USFWS 1998b). Most sightings of loggerheads are of juveniles which have moved into Southern California waters while visiting important foraging areas off the coast of Baja California; adults are rarely seen (NMFS and USFWS 1998c). The leatherback is commonly sighted along the West Coast of the U.S. as it disperses from its breeding grounds along the coast of Mexico (NMFS and USFWS 1998d). In general, green and olive ridley turtles occupy shallow, nearshore zones and leatherbacks and juvenile loggerheads may be found over all water depths.

3.4 MARINE MAMMALS

3.4.1 Background

Marine mammals include a diverse assemblage of animals uniquely adapted for life in the sea. Cetaceans (whales, dolphins, and porpoises) are commonly divided into two groups: those with teeth for grasping prey (odontocetes), and those that use baleen to filter prey from sea water (mysticetes). Pinnipeds (seals, sea lions, and walruses) are somewhat less marine-adapted in that they routinely haul-out on land to breed and molt. Mustelids (sea otters), sirenians (manatees and dugongs), and ursids (polar bears) complete the list of mammalian orders that have adapted to the marine environment.

Marine mammals are abundant in waters offshore of the U.S. West Coast, with a strong seasonal occurrence for some species (Barlow 1995; Forney et al. 1995). Upwelling each winter and spring, followed by a period of relatively warm stratified conditions during summer and autumn modifies continental slope and shelf waters. While the occurrence and migrations of some mysticete species relative to this seasonal occurrence is comparatively well documented (e.g., blue and gray whales), it is less well described for most odontocete species.

The NMFS provides a comprehensive assessment of all marine mammal populations offshore the U.S. West Coast and furnish descriptions of geographic range and estimates of abundance for each stock (Barlow et al. 1997). In addition, Barlow (1997) updated abundance estimates for waters to 556 km (300 nm) offshore of California, Oregon, and Washington, based upon a large-scale ship survey conducted during the summer-autumn of 1996. The following description of marine mammal abundance and distribution for the proposed PSS ocean test locations relies on information contained in these documents, augmented by additional references as required.

3.4.2 PSS Ocean Test Location

3.4.2.1 Proposed PSS Ocean Test Location

The proposed location for the PSS ocean test is in the SCB, an area 65 km (35 nm) east-southeast of Catalina Island and outside of the 3 nm California coastal boundary area (refer to Figure 2-5). At least 29 species of marine mammals occur in this area, with seasonal shifts in dominant fauna described for some (Table 3-3). For example, gray whales are the most common mysticete in Southern California waters during winter and spring, while blue, fin, humpback, and minke whales are far more common in summer and autumn. Although Sei (or Bryde's) are uncommon in both seasons, individuals have been reported in the general area of the proposed test location throughout the year. Only four northern right whales have been seen in Southern California waters since 1981 (Figure 3-3); and only one of the sightings was located anywhere near the proposed PSS ocean test boundary. Five additional sightings were reported elsewhere in the eastern North Pacific since 1995. The significance of this is underscored when one considers there were only 10 reliable sightings reported for this species in California waters between 1900 to 1982 (Scarff 1986, 1991; Carretta et al. 1994; Evans 1998).

Table 3-3. Marine Mammals Common to Waters Offshore California

Common Name	Scientific Name	Stock	Status[1]	Pop. Estimate (CV)[2]	Winter/ Spring	Summer/ Fall
Mysticetes						
Gray whale	*Eschrichtius robustus*	East. N. Pacific	NL	22,263(0.09)*	Common	Uncommon
Blue whale	*Balaenoptera musculus*	CA	E	2,146 (0.23)	Uncommon	Common
Fin whale	*Balaenoptera physalus*	CA	E	1,896 (0.59)	Uncommon	Common
Minke whale	*Balaenoptera acutorostrata*	CA	NL	446 (0.44)	Uncommon	Common
Humpback whale	*Megaptera novaeangliae*	CA	E	1,701 (0.33)	Uncommon	Common
Bryde's whale	*Balaenoptera edeni*	CA (1991/93)	NL	24 (2.0)	Uncommon	Uncommon
Sei (or Bryde's) whale	*Balaenoptera borealis*	CA (I 991/93)	E	36 (0.71)	Uncommon	Uncommon
Northern right whale	*Eubalaena glacialis*	N. Pacific	E	16 (1.1 1)**	Uncommon	Uncommon

Common Name	Scientific Name	Stock	Status[1]	Pop. Estimate (CV)[2]	Winter/ Spring	Summer/ Fall
Odontocetes						
Sperm whale	*Physeter macrocephalus*	CA	E	503 (0.42)	Common	Common
Pygmy (or dwarf) sperm whale	*Kogia breviceps*	CA (1991/93)	NL	3,145 (0.54)	Uncommon	Uncommon
Killer whale	*Orcinus orca*	CA	NL	323 (0.60)	Uncommon	Uncommon
Baird's beaked whale	*Berardius bairdii*	CA	NL	157 (0.53)	Uncommon	Common
Cuvier's beaked whale	*Ziphius cavirostris*	CA	NL	2,162 (0.55)	Uncommon	Uncommon
Beaked whales spp.	*Mesoplodon spp*	CA(1991/93)	NL	1,378 (0.58)	Uncommon	Uncommon
Risso's dolphin	*Grampus griseus*	CA	NL	7.366 (0.52)	Common	Uncommon
Short-finned pilot whale	*Globicephala macrorhynchus*	CA (1991/93)	NL	1,004 (0.37)	Common	Uncommon
Northern right whale dolphin	*Lissodelphis borealis*	CA	NL	91131 (0.77)	Common	Uncommon
Long-beaked common dolphin	*Delphinus capensis*	CA	NL	72,251 (0.83)	Uncommon	Common
Short-beaked common dolphin	*Delphinus delphis*	CA	NL	326,815 (0.42)	Common	Common
Striped dolphin	*Stenella coeruleoalba*	CA	NL	5,734 (0.55)	Uncommon	Common
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	CA	NL	60,026 (0.84)	Common	Uncommon
Bottlenose dolphin	*Tursiops truncatus*	CA	NL	320 (0.43)	Common	Common
Dall's porpoise	*Phocoenoides dalli*	CA	NL	60,756 (0.50)	Common	Uncommon
Pinnipeds						
California sea lion	*Zalophus c. californianus*	U.S.	NL	167,000-188,000	Common	Common
Harbor seal	*Phoca vitulina*	CA	NL	30,293-188,000	Common	Common
Northern elephant seal	*Mirounga anzustirostris*	CA Breeding	NL	84,000-188,000	Common	Uncommon
Guadalupe fur seal	*Arctocephalus townsendi*	CA/Mexico	T	7,408-188,000	Uncommon	Uncommon
Northern fur seal	*Callorhinus ursinus*	San Miguel Is.	NL	10,036-188,000	Common	Uncommon
Mustelids						
Southern sea otter	*Enhydra lutris neresis*	Experimental population	T	< ~50	Uncommon	Uncommon

Sources: Population Estimates
Cetaceans – Barlow 1997 Pinnipeds – Barlow et al. 1997
* Hobbs et al. in press
** Forney et al. 1995

[1]Status: E = Endangered
T = Threatened
NL = Not Listed

[2]CV = Coefficient of variation

Figure 3-3. Right Whale Sightings within the Southern California Bight

Short-beaked common dolphins are the most ubiquitous odontocete in Southern California waters, with higher abundance reported for summer-fall than winter-spring. Other toothed whales that follow this seasonal pattern include long-beaked common dolphins, striped dolphins, and Baird's beaked whales.

Conversely, Risso's dolphins, short-finned pilot whales, northern right whales, Pacific white-sided dolphins, and Dall's porpoise are more common in winter-spring than in summer-autumn. Toothed whales for which seasonal shifts in occurrence have not been described, include sperm whales, pygmy sperm whales, killer whales, beaked whales (including Cuvier's), and bottlenose dolphins. Some species seem to prefer specific bathymetric habitat. For example, sperm whales, pygmy sperm whales, and beaked whales are commonly associated with deep water seaward of the continental shelf/slope, while some stocks of bottlenose dolphin are clearly associated with very shallow coastal areas Pinnipeds inhabit the SCB year-round, although species presence and abundance vary significantly from season to season (Reeves et al. 1992). Four pinniped species establish seasonal rookeries in the Channel Islands for pupping, mating, and molting (Table 3-4, Figure 3-4). One species, the Guadalupe fur seal, occasionally hauls out on some of the Channel Islands but does not currently breed there. Because pinniped time at sea varies significantly with each activity, a brief synopsis of pupping, mating, molting, and feeding is provided below.

Most phocids (i.e., hair or true seals, including harbor seals and elephant seals) fast as they nurse their pups with extremely rich milk for a relatively short period of time (4 days to a few weeks), then abandon the pups to return to the sea to replenish fat reserves (Reeves et al. 1992). Harbor seals are an exception to the normal phocid pattern in that they often feed while lactating, taking their pups along with them. Harbor seals in Southern California give birth in March and April.

Otariids (eared seals and sea lions) do not produce milk rich as that of phocids and must regularly return to the sea to feed during lactation. California sea lions give birth at rookeries on San Miguel, San Nicolas, Santa Barbara, and San Clemente islands in May and June and remain in the area alternating between feeding and nursing through August. There is also a small breeding colony of northern fur seals on San Miguel Island; females arrive in June to pup and remain in the local area until October or November when the pups are weaned.

Table 3-4. Pinniped Breeding, Molting, and Feeding Cycle in the SCB

		Month											
Species		J	F	M	A	M	J	J	A	S	O	N	D
Harbor seal	Primary behavior	F	F	B	B	M	M	M	M	F	F	F	F
	Age Class	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀	♂ ♀
N. elephant seal	Primary behavior	B	B			M	M	M	M				B
	Age Class	♂ ♀	♂ ♀			♀ *	♀ *	♂	♂				♂ ♀
CA sea lion	Primary behavior	M	M			B	B	B	F	M	M	M	M
	Age Class	♂	♂			♂ ♀	♂ ♀	♂ ♀	♀ *	♀ *	♀	♂	♂
N. fur seal	Primary behavior	F	F	F		B	B	B	B	B	B	B	
	Age Class	♀ *	♀ *	♀ *		♂	♂ ♀	♀	♀	♀	♀	♀	

Notes:
F = Feeding
M = Molting
B = Pupping/Mating

♂ = adult males
♀ = adult females
* = juveniles

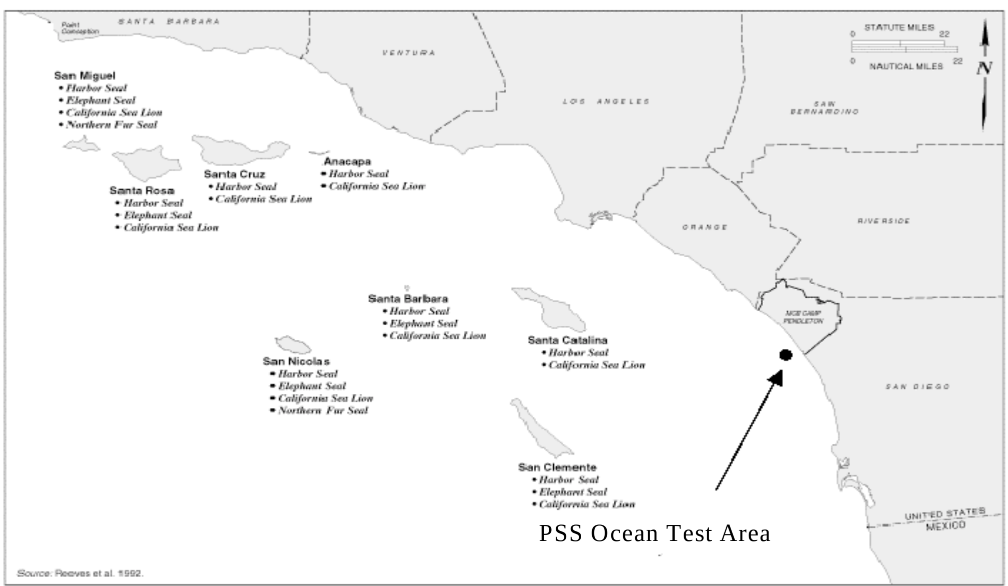

Figure 3-4. Pinnipeds of the Channel Islands

Mating takes place usually within a few days to a few weeks after pupping (Reeves et al. 1992). Pinnipeds that pup on land (as opposed to ice) usually return to the same rookery every year. During the pupping/mating season, males of most species remain onshore defending territories. After the mating season, males leave the rookeries and often migrate great distances. For example, male California sea lions that mate at rookeries in the Channel Islands migrate to beaches in Washington and British Columbia to molt, male California sea lions that molt in the Channel Islands have migrated there from Baja California. Male northern fur seals that mate in the Channel Islands probably spend the rest of year in Alaska near the Aleutian Islands.

Both phocids and otariids molt annually to replace skin and hair (Reeves et al. 1992). During the molt, pinnipeds generally do not eat and most do not enter the water at all. Different age and sex classes usually molt at different times or at different locations. Harbor seals and northern elephant seals molt at rookeries in the Channel Islands in spring and summer; California sea lions molt in fall and winter. Northern fur seals do not undergo molting in Southern California.

When not involved in pupping, mating, or molting activities, pinnipeds spend the majority of time at sea, occasionally hauling out on rocks or beaches (Reeves et al. 1992). The SCB is a feeding ground for all four species of pinniped regularly found there. Harbor seals generally feed at depths averaging 17-87 m (55-285 ft), while elephant seals are deep divers 370-480 m (1,200-1,575 ft). California sea lions feed at depths from 26-74 m (85-240 ft), and gravitate towards areas of upwelling south of San Miguel Island.

Sea otters are not commonly seen in Southern California waters. However, the USFWS translocated over 100 individuals to San Nicolas Island in the late 1980s. Most of those animals returned to their capture site off of central California or are otherwise missing. A few individuals remained, however, and have established a small breeding colony at San Nicolas Island.

Area within Territorial Waters

Mysticete and odontocete abundance within territorial waters (12 nm) of an island or coastal shoreline will generally be greater than waters farther offshore because, as a rule, continental shelf and slope waters are more productive than waters that overlie basins. The Southern California test area represents a region of highly varied bathymetry and is often described as "topographically complex," with a narrow continental shelf, distinct basins interrupted by subsurface ridges and banks, and various islands (refer to Figure 3-1) (Winant 1990). Bathymetric complexity affects current patterns and influences upwelling, which in turn affects productivity over the test area. For example, blue and fin whales feed on euphausiid swarms in waters between Point Conception and the four northern Channel Islands from July through October (Fiedler et al. 1995). The dense prey swarms are associated with summer upwelling along the California coast, with prey often found in the waters of the Santa Barbara Channel. In addition to coastal feeding, gray whales commonly migrate close to the coast and island shorelines in winter and spring (Poole 1984; Sumich and Show in press). Specifically, gray whales migrating through the Channel Islands were primarily found within 5.6 km (3 nm) of the islands, with clustering reported in the channels between the northern islands (Jones and Swartz in press). Finally, the range of some subpopulations of bottlenose dolphins appears restricted to coastal waters, while other groups range far offshore (Hansen 1990).

Pinniped abundance within territorial waters of an island or coastal shoreline will generally be greater than outside of territorial waters, particularly just prior to or just after the pupping/mating season or molting. At any time of the year, at least one species of pinniped is just leaving or just returning to rookeries in the Channel Islands (refer to Table 3-4). Female California sea lions and northern far seals will regularly leave the rookeries while nursing to forage both near the rookeries as well as several hundred kilometers distant. Furthermore, harbor seals will remain in nearshore areas year-round.

Newborn pups and weaners will remain near the rookeries for several weeks, venturing only into shallow water as they learn to swim.

Although sea otter occurrence in the SCB is sparse, if encountered they would most likely be within territorial waters of one of the offshore islands. It would be extremely rare to encounter a sea otter outside territorial waters.

3.4.3 Acoustic Issues

Marine mammals rely on acoustics to sense their environment and to communicate with one another. As discussed earlier, marine mammals are a diverse assemblage and as such produce many kinds of sounds ranging from infrasonic to ultrasonic frequencies. Hearing capabilities are thought to vary widely between species. Because underwater sound is so important to marine mammals, analysis of potential acoustic impacts of the PSS ocean tests is emphasized in this EA. This section briefly summarizes the characteristics of marine mammal calls and hearing as a foundation for assessment. A comprehensive review of these topics is available in Richardson et al. (1995).

3.4.3.1 Call Characteristics and Hearing Abilities

In the absence of species specific data on auditory capabilities and injury thresholds, information regarding marine mammal calls provides some indirect clues about the risk posed by loud underwater noise at specific frequencies. Characteristics and functions of marine mammal calls are important to the analysis in this EA for several reasons:

- call characteristics determine the likelihood of acoustic masking by specific types of anthropogenic noise;
- call functions (if known) can determine the potential consequences of masking; and
- call characteristics provide indirect evidence about the hearing abilities of marine mammal species for which no audiograms exist.

Hearing abilities vary greatly among the different groups of marine mammals (Schusterman 1981; Ketten 1992). Indeed, a given species hearing ability will determine whether an anthropogenic sound:

- will be inaudible, barely audible, or prominent (i.e., likely to disturb an animal);
- will mask natural sounds at similar frequencies; or
- will cause auditory or other injuries.

Concepts routinely used when discussing marine mammal hearing ability include audiograms, absolute threshold, critical bandwidth, and critical ratio. An *audiogram* is a graph of absolute threshold versus frequency. The *absolute threshold* represents the lowest sound level, at a given frequency, that can be detected by an animal in the absence of appreciable background noise. Background noise can interfere with, or mask, the ability of an animal to detect a signal. It is primarily the background noise within a frequency band near the signal frequency that affects the detectability of that signal. This bandwidth is called the *critical bandwidth.* Measurements of a closely related and more easily measured parameter, called the *critical ratio,* are commonly used in characterizing hearing abilities in the presence of background noise. The *critical ratio* is the signal-to-noise (S/N) ratio required to detect a pure tone sound signal in the presence of background noise. In this case, background noise (also called, ambient noise) is measured on a "per hertz" or "spectrum level" basis (in dB re 1 $\mu Pa^2/Hz$). A *critical ratio* of 20 dB at a particular frequency means that a tone at that frequency must be 20 dB or more above the spectrum level (Hz) of background noise in order to be detected. Except at very low frequencies, critical ratios and critical bandwidths tend to increase with increasing frequency (Richardson et al. 1995).

<u>Odontocetes (Toothed Whales)</u>

Calls

Most odontocetes produce sounds that fall into three general categories: (1) echolocation clicks (short-duration, high-frequency pulsed sounds); (2) tonal whistles, often used for communication; and (3) highly varied pulsed sounds, some used for communication and others of uncertain function.

Much of the research on odontocete whale calls has focused on the first type-the ultrasonic (above 20 kHz) echolocation clicks (Au 1993). Most odontocetes studied to date seem to use these sounds for navigation, orientation, and feeding. The sounds to which marine mammals might be exposed during the proposed PSS test are mostly at much lower frequencies. In dolphins, as well as in terrestrial mammals, anthropogenic sounds at low frequencies have very little if any masking effect on high frequency signals such as those used in echolocation (Au 1993; Richardson et al. 1995). Therefore, interference with echolocation signals is not considered an issue.

Most odontocetes produce narrowband whistles at frequencies from 1-20 kHz, below the frequency of the echolocation signals but, still above the frequency range of most vessel and test sounds that might be encountered during the proposed PSS ocean tests.

Whistles are quite varied within and among species, with at least one report of lower-frequency whistle-like sounds reported for bottlenose dolphins (Schultz et al. 1995). In general, whistles are thought to be communicative in function, used to coordinate activities among individuals. However, the specific biological functions of most whistle types are largely unknown.

Some odontocetes also produce low- to moderate-frequency "pulsed calls" that appear to serve a communicative, rather than an echolocative, function. These pulsed sounds are normally broadband in nature and often sound like a "rasp" or "Bronx cheer." Often pulsed sounds include significant energy below 1 kHz, but many of these same pulses include energy at higher frequencies as well. Some toothed whales (e.g., sperm whales and porpoises) are not known to whistle, and their acoustic communication may depend exclusively on pulsed sounds.

The ultrasonic echolocation pulses of medium-sized species can have a very high peak source level, up to 225-230 dB re 1 μPa-m. However, these signals are very brief and thus contain relatively little energy. Also, the smaller dolphins and porpoises do not emit such strong echolocation signals (Au 1993). Even the strongest echolocation signals are not detectable at long ranges because ultrasound is rapidly absorbed in seawater and because echolocation signals are highly directional.

Source levels of odontocete whistles and pulsed calls are extremely variable, and available data are often imprecise because of various measurement problems both in the field and in captivity. Source levels of communication calls may range from seemingly very weak signals (100-125 dB) by some small species to rather strong pulses by sperm whales (160-180 dB) and strong whistles by pilot whales

(180 dB) (Richardson et al. 1995). Many odontocete calls cannot be detected by simple hydrophones at distances beyond about 0.5-2 km (0.3-1.2 miles). However, sperm whale “clicks" are often detectable up to 5-10 km (3-6 miles) away.

Hearing

Underwater audiograms have been published for eight species of small- to moderate-sized odontocetes, including bottlenose dolphins, killer whales, harbor porpoises, and Risso's dolphins (Figure 3-5). In general, in the absence of significant background noise, toothed whales can hear sounds over a very wide range of frequencies, from as low as 40-75 Hz in bottlenose dolphins and white whales (beluga), to as high as 80-150 kHz for most other species (Richardson et al. 1995). Hearing in most small- and moderate-sized odontocetes is most sensitive at high frequencies, i.e., between about 10-90 kHz. At these frequencies, absolute thresholds are in the range of 40-60 dB.

Standard threshold measurements, as summarized above, refer to detection of pure tones of relatively long duration (greater than 0.5 second). For pulses less than 0.2 seconds in duration, odontocete detection thresholds are higher (Johnson 1968, 1991). On the other hand, the threshold for detection of a sequence of pulses is lower than that for a single pulse. These results may be relevant because the projected impulsive sounds to be used during the PSS ocean test would be sequences of short (roughly 24 msec) impulses at 15 second intervals or greater.

The effects of masking by background noise (the general principles of masking are discussed in Section 3.4.3.2) on the hearing abilities of odontocetes have been studied for bottlenose dolphins, false killer whales, and white whales (Au 1993; Richardson et al. 1995). For the bottlenose dolphin, a pure-tone signal at 6 kHz must exceed spectrum level ambient noise by 22-28 dB to be detected, whereas a 70 kHz tone must exceed spectrum level ambient noise by about 40 dB (Johnson 1968). Critical ratios for the bottlenose dolphin have not been measured below 5 kHz, but those of white whales have been measured from 40 Hz to 115 kHz. The critical ratios of a white whale remained nearly constant, near 17 dB, from 40 Hz to 3 kHz, then rose gradually above 3 kHz (Johnson et al. 1989). At ultrasonic frequencies, susceptibility to masking depends strongly on the relative directions of arrival of the signal and the masking noise. At moderate and probably at low frequencies, these directional effects on masking are reduced or absent (Bain and Dahlheim 1994). Direct auditory measurements have not been obtained from any of the larger odontocetes, aside from some high-frequency data from a beached sperm whale calf (Carder and Ridgway 1990).

<u>Mysticetes (Baleen Whales)</u>

Calls

All mysticete whales emit underwater calls at low to moderate frequencies (Richardson et al. 1995). Frequencies range from roughly 12-14 Hz (i.e., infrasonic sound) for the lowest-frequency components of some blue and fin whale calls, up to 2-8 kHz for the highest-frequency components produced by some species (e.g., humpback whales). Higher-frequency clicks have occasionally been reported, but the accuracy of these reports is uncertain. Most mysticete calls have energy centered at frequencies below 1 kHz, and nearly all blue and fin whale calls have energy centered at 15-25 Hz. Mysticete calls are often brief (1-4 seconds), but are sometimes emitted in long sequences, as in the case of humpback

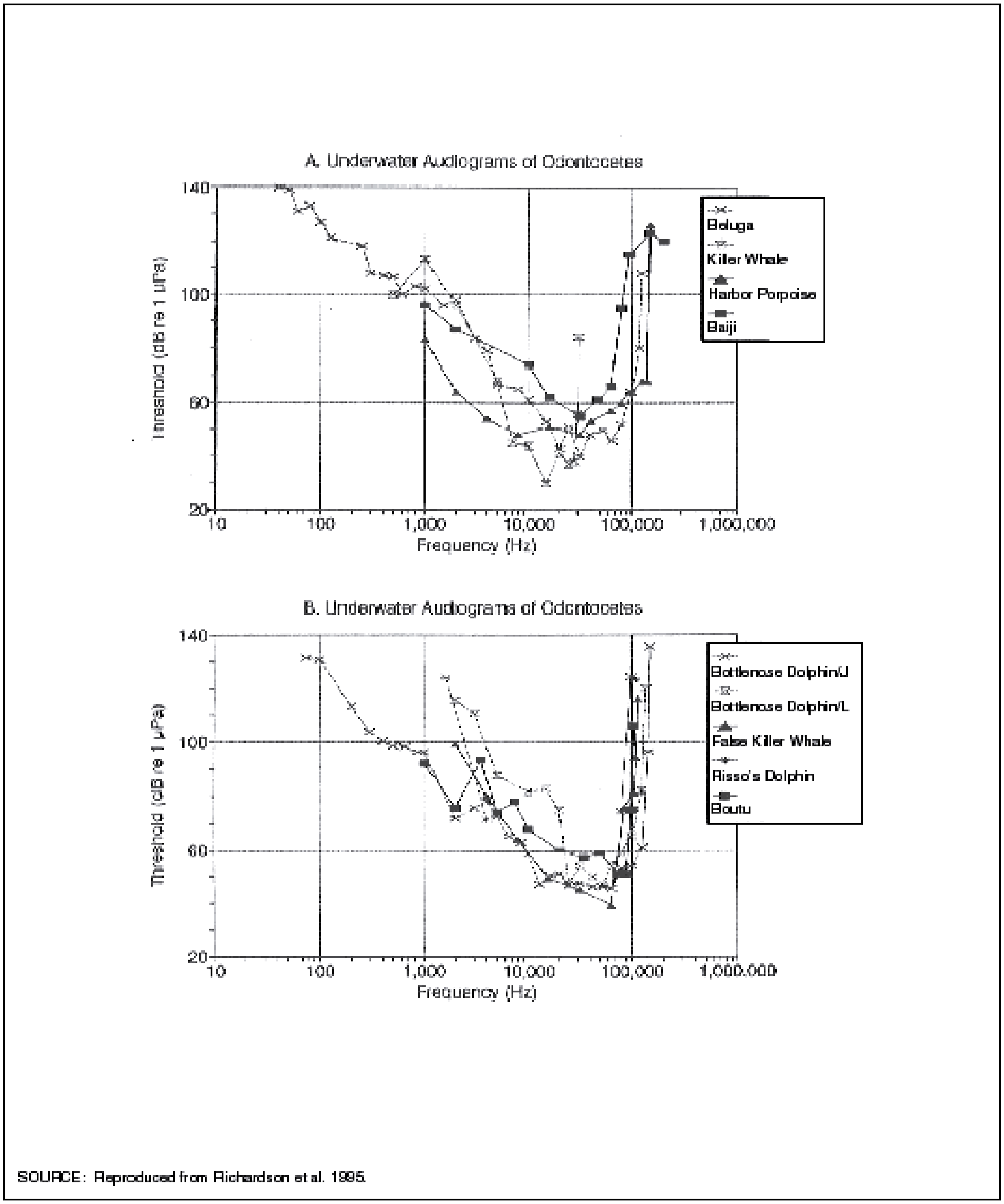

Figure 3-5. Underwater Audiograms of Odontocetes

whales songs. Blue whales produce long stereotypic calls that last 19 seconds or more and are often given in series.

Source levels of mysticete whale calls are highly variable. The strongest calls by several species of baleen whales (e.g., blue, fin, humpback, right, and bowhead whales) are in the range of 180-190 dB. However, many calls are considerably weaker. In continental shelf waters, calls of humpback, fin, and bowhead whales are often detectable by simple hydrophones at distances ranging up to at least 10-20km (6-12 miles); detection ranges are longer in deep offshore waters (Watkins et al. 1987; Clark and Ellison 1988; Helweg et al. 1992).

Functions of most mysticete calls are not well documented, but presumably involve intraspecific communication and coordination in most cases. However, there is increasing speculation that some species may obtain useful navigational information from the reverberations or echoes of their low-frequency calls from large underwater objects (Ellison et al. 1987).

Hearing

No direct audiometric studies have been conducted on baleen whales, but there is strong indirect evidence that they are well adapted for hearing low- and moderate-frequency sounds. The anatomy of baleen whale ears is adapted for detecting low frequencies, apparently including infrasonic (less than 20 Hz) sounds in some species (Ketten 1992, 1994). Various species have exhibited behavioral reactions

to low frequency (less than 1 kHz) sounds from other whales and from actual or simulated sources of anthropogenic noise (Richardson et al. 1995). Watkins (1986) noted that mysticetes often react to sounds with frequencies from 15-28 kHz, but not to pingers and sonars at 36 kHz and above. The fact that most sounds produced by baleen whales are at frequencies less than 1 kHz is a further indication of their sensitivity to lower-frequency sounds. Presumably, mysticetes are well adapted to hear the types of sounds made by members of their own species.

The actual hearing sensitivity of baleen whales at different frequencies is not known with certainty. However, at low frequencies, mysticete hearing is probably sensitive enough that ambient noise rather than the absolute hearing thresholds of the whales limit detection of sound signals. Baleen whales probably have some directional hearing ability, even at low frequencies, as they sometimes move toward calling conspecifics and either away from or toward sources of some low-frequency anthropogenic noises (Richardson et al. 1995). Directional hearing at low frequencies probably reduces masking effects at those frequencies.

<u>Pinnipeds (Seals and Sea Lions)</u>

Calls

Pinnipeds produce calls both in the air and, for many species, under-water. Underwater calls are more common for species that mate in the water, like harbor seals; some of these species produce strong underwater calls that propagate for long distances. Harbor seals socialize and call both in air and in the water; the male's reproductive display includes repeated trains of 20 ms pulses at 4 kHz emitted underwater and accompanied by bubble blowing, roars, grunts, and creaks (Hanggi and Schusterman 1994). Elephant seals and eared seals mate on land and produce many airborne sounds; their underwater call repertoire is poorly known, but can include barks and sometimes clicks. Both underwater and in-air calls of pinnipeds are typically at frequencies ranging from a few hundred to a few thousand Hz. Pinnipeds do not appear to echolocate.

Hearing

Studies of pinniped hearing have been conducted on both phocids and otariids for underwater and in-air hearing (Richardson et al. 1995). In general, pinniped hearing abilities are less specialized than those of cetaceans. Highest sensitivity for phocids tested underwater usually occurs from 1 kHz to 30-50 kHz, with thresholds of 60-85 dB. Sensitivity deteriorates below 1 kHz. However, phocids are more sensitive than odontocetes at lower frequencies: 96 dB at 100 Hz in the harbor seal, and lower in the northern elephant seal (Kastak and Schusterman 1995). Thresholds deteriorate (increase) when the sounds are pulses less than 0.05 second in duration (Terhune 1988), but improve (decrease) when sound pulses are in sequences rather than single (Turnbull and Terhune 1993).

Otariids listening underwater have similar or slightly better sensitivity than phocids within their frequency range of best hearing. However, this frequency range is apparently narrower than in phocids, with a high-frequency cutoff at about 36-40 kHz. Northern fur seal hearing is most sensitive at 4 to 17-28 kHz, where the absolute threshold is about 60 dB (Moore and Schusterman 1987; Babushina et al. 1991). California sea lion hearing is most sensitive in the 2-16 kHz range, apparently with higher absolute thresholds than in the fur seal. The sea lion hearing threshold rises from about 85 dB at 1 kHz to 116-120 dB at 100 Hz (Kastak and Schusterman 1995), indicating that they may be less sensitive to low-frequency sounds than are phocids.

Both otariids and phocids hear in-air as well as underwater sounds. Highest sensitivity to airborne sounds are in the 1-2 to 8-16 kHz range. Otariids may have slightly higher sensitivity and a higher high-frequency cutoff than do phocids. In-air hearing sensitivity deteriorates below 2 kHz, but strong sounds at frequencies as low as 100 Hz are detectable. Pinnipeds are less sensitive than humans to airborne sounds below 10 kHz (Richardson et al. 1995).

Auditory masking has been studied in a few pinnipeds and is similar to that in other mammals. In both harbor and northern fur seals, critical ratios for underwater hearing increased from 19 dB at 2-4 kHz to 27 dB at 32 kHz (Moore and Schusterman 1987). Critical ratios are similar for underwater and in-air listening.

3.4.3.2 Masking Effects

Background noise can interfere with, or mask, the ability of an animal to detect a sound. It is primarily the background noise within a band of frequencies near the signal frequency that affects the detectability of that signal. Auditory masking is, in part, a natural phenomenon to which marine mammals are adapted. Even in the absence of any human activities, there is natural ambient noise caused by wind, waves, surf, precipitation, and animals. This ambient noise limits the distances over which marine mammals can hear natural sounds relevant to them, including calls from conspecifics and predators. The longer the distance from any sound source, the lower the expected received level. At some distance, the received level of that sound diminishes below the ambient noise level at similar frequencies. At about that distance, the sound becomes undetectable. The distance at which a given sound will fall below the natural ambient noise level and become undetectable varies greatly from day to day and place to place, in large part because the level of natural ambient noise is highly variable depending on factors including wind speed, precipitation, vessel traffic, and the presence of call animals nearby.

Marine mammals are adapted to life in an environment where sounds from sources beyond some variable distance are inaudible because of propagation loss and masking by ambient noise. The need to detect specific sound signals in the presence of natural background noise is one of the primary selection pressures that have shaped the evolution of the auditory systems of marine mammals.

The total background noise level, including both natural ambient noise and any anthropogenic noise determines the maximum detection radius of a given sound signal. In recent history, anthropogenic noise is a frequent and sometimes dominant component of the total background noise in the ocean. When the level of anthropogenic noise equals or exceeds the natural ambient noise level, the total background noise level is increased appreciably, reducing the detection radius for any sound signal at similar frequency (Richardson et al. 1995).

In evaluating the potential for background noise (natural and/or anthropogenic) to mask a sound signal, the relevant frequencies are primarily those of the signal plus adjacent frequencies that are within the critical band(s) around the frequency(ies) of the sound signal. Thus, a sound signal may be masked by background noise at the same frequency or a nearby frequency. However, there will be little masking effect by background noise at a very different frequency.

Masking is a quantitative, not an "all-or-none," process. When masking does occur, the effect is to reduce the radius around the source of a sound within which that sound will be detectable. At closer distances, the sound signal will still be above the background noise level at corresponding frequencies and will remain detectable. At longer distances, the sound signal is too low relative to the then-prevailing background noise level (natural and/or anthropogenic). Directional effects further complicate the process. At least at higher frequencies, background noise arriving from directions similar to the arrival direction of the sound signal has a strong masking effect, but background noise arriving from another direction may have less masking effect (Bain and Dahlheim 1994). The directional properties of both the signal and the background noise may affect the detectability of the signal. Another complication is that a rapid sequence of brief sounds is more detectable amidst background noise than is a single brief sound (e.g., Au 1993; Turnbull and Terhune 1993).

3.5 TERRESTRIAL BIOLOGY

3.5.1 Background

Biological resources include native or naturalized plants and animals and the habitats in which they occur. Sensitive biological resources are defined as those plant and animal species listed as threatened or endangered, or proposed as such, by the USFWS under the ESA, or the CDFG Federal Species of Concern, formerly known as Category 2 candidate species. These species are not protected by law; however, they could become listed and therefore protected at any time. Additionally, the California National Heritage Program (CNHP) maintains databases of state species of concern, many of which are not afforded legal protection.

3.5.2 PSS Ocean Test Location

3.5.2.1 Proposed PSS Ocean Test Location

The proposed PSS ocean test site is located within the SCB (refer to Figure 2-5). Coastal or offshore aquatic habitats in the SCB are used by more than 195 species of birds.

Although population numbers have not been accurately determined, breeding birds number in the thousands and migratory populations number in the millions. The SCB is the northern or southern limit of breeding ranges for many species and is the only California breeding location for black storm-petrels *(Oceanodroma melania),* Xantus' murrelets *(Synthliboramphus hypocleucus),* and brown pelicans *(Pelecanus occidentalis)* (Baird 1993)).

Due to their high mobility, the majority of birds found in the SCB regularly move in and out of the SCB during foraging trips or migration through the area. Some species use only the coastal marshes and estuaries while others use both inshore and offshore marine waters.

The greatest biomass of birds that use the SCB include seabirds, scoters, loons, and western grebes *(Aechmophorus occidentalis).* The most numerous seabirds include shearwaters, storm-petrels, phalaropes, gulls, terns, and auklets. In addition to those species breeding in the SCB, numerous species overwinter or migrate through. The visitors are predominantly southern breeders in the spring, subtropical breeders in the fall and mainly Alaskan breeders in the winter. Seabird diversity is highest in fall to early spring, reflecting the arrival of species that nest outside the SCB, and lowest from May to August. Except for terns and skimmers, all seabirds that breed in the SCB nest on the Channel Islands (Baird 1993).

Common birds that use the nearshore and offshore marine waters within territorial waters off MCB Camp Pendleton include Heermann's gulls *(Larus heermanni),* ring-billed gulls *(Larus delawarensis),* California gulls *(Larus californicus),* common terns *(Sterna hirundo),* elegant terns *(Sterna elegans),* Forster's terns *(Sterna forsteri),* Brandt's cormorants *(Phalacrocorax penicillatus),* western grebes, and surf scoters *(Melanitta perspicillata).*

3.6 LAND USE, TRANSPORTATION, AND RECREATION

3.6.1 Background

Land use is the classification of either natural or human-modified activities occurring at a given location. Examples of land use in an ocean environment include shipping, tourism, military, commercial and recreational fishing, and other recreational activities. Types of offshore activities suitable for given areas are often addressed by state and local coastal management programs that have been established to comply with the Coastal Zone Management Act (CZMA) of 1972 et seq. For the proposed action, the California Coastal Commission administers the CZMA. To obtain approval from state and local agencies for offshore actions, it is typically necessary to obtain appropriate permits and to enter into a lease agreement with the appropriate state lands management agency.
Traffic issues generally refer to transportation and circulation of ground vehicles in the relationship of the ability of a road system to accommodate varying levels of traffic burdens. Marine traffic issues address ocean vessel movement in port, nearshore, and in open ocean environments. Traffic issues related to the PSS ocean test are associated with the addition of two offshore vessels and the moored barge, with only one of the offshore vessels being used at any given time. Transportation issues for

ship traffic have similarities to onshore traffic systems; however, ship traffic has a greater flexibility than land routes for structuring courses and paths that a particular ship or boat may take. Routes used for commercial shipping (characterized by use of large cargo, container vessels, or tankers) are highly structured and controlled, even in open ocean areas. For smaller boats, the only limiting factor on a specific body of water is the availability of adequate depth.

3.6.2 PSS Ocean Test Location

3.6.2.1 Proposed PSS Ocean Test Location

Land Use/Recreation

The proposed ocean test location would be located off the coast of Southern California (refer to Figure 2-5). Waters offshore of Southern California are heavily utilized for commercial uses, recreational and military activities, and limited oil and gas production facilities.

Commercial uses primarily comprise commercial fishing, diving, and trapping. These activities occur at various locations off the coast of Southern California. The Channel Islands are extremely productive commercial fishing areas. The nearshore waters along the coast and the waters just off the islands contain giant kelp beds, which provide habitats for a number of different species. Fishery seasons are established and regulated by the CDFG. A detailed discussion of the economic elements of commercial fishing is presented in Section 3.7, Socioeconomics.

The commercial harvest of kelp and other marine vegetation near the coastline is becoming a more established industry in Southern California. Live fish trapping (e.g., rockfish, sheephead, and sea bass) occurs primarily in the shallower waters near the coastline of the Channel Islands. Lobsters are fished in coastal waters because they are typically most abundant in rocky areas with kelp in waters of 30 m (100-ft) or less in depth. Most of the waters off the islands are conducive to this habitat since the islands generally have an offshore shelf that extends out gradually into deeper waters. Commercial drift gill netting for pelagic shark and swordfish occurs in the open waters throughout portions of Southern California. This fishery, however, is only a small portion of the total industry in Southern California.

Recreational activities occur primarily in nearshore areas of Southern California. Examples of common recreational activities include sport fishing, sailing, boating, and swimming. In addition, the coastal and offshore marine environments are popular locations for tourist activities including sightseeing, whale watching, sport fishing, pleasure boating, and diving.

Recreational fishing involves hook-and-line fishing from piers and docks, jetties and breakwaters, beaches and banks, private or rental boats, and commercial passenger fishing vessels. Hook and line fisheries are not allowed within the state waters of California (5.6 km [3 nm] offshore); the main species caught in hook and line fisheries is rockfish. Recreational fishing also includes activities such as spear and net fishing. Recreational fisheries in Southern California access both nearshore and offshore areas, targeting both groundfish and mid-water fish species.
According to catch records, Southern California is a leading recreational fishing area along the West Coast (CDFG 1996). The weather and sea conditions allow for year-round fishing activity. Although the majority of kelp beds are within 1.8 km (1 nm) of shore, some fishing areas extend as far as 9 km (5 nm) from shore. Commercial passenger fishing vessels frequently take 1-day sport fishing

excursions from the various ports within Southern California. Types of fish landed on commercial passenger fishing vessels include kelp bass, mackerel, sheephead, halfmoon, and whitefish, which indicates that sport fishing generally takes place in relatively shallow waters (approximately 18 m [60 ft] or less).

Recreational activities in Southern California other than rod and reel fishing include scuba diving for spiny lobster, scallop, and abalone as well as spear fishing for rockfish, sheephead, and swordfish. These activities also occur primarily in shallow waters near the coastline.

Federal leasing of offshore lands for oil and gas production began in 1963, following 10 years of state leasing of offshore areas. Numerous oil platforms and exploratory drilling rigs are located from Los Angeles to the Santa Barbara Channel, both in state waters (out to 5.6 km [3 nm]) and federal waters (beyond 5.6 km [3 nm]). Several of these rigs and platforms are in the process of being decommissioned.

Transportation

The U.S. Coast Guard (USCG) typically establishes maritime traffic routes. The major purpose of these routes (often referred to as shipping lanes) is to allow access to and from major ports for large commercial marine vessels, while also allowing an adequate separation scheme for other types of offshore activities. Commonly used commercial shipping routes include a major shipping lane that transits the Santa Barbara Channel; this route is the most heavily traveled traffic lane used by commercial cargo vessels in the waters of Southern California. This Traffic Separation Scheme (TSS) established by the USCG runs just north of, and roughly parallel with, the northern Channel Islands. The TSS is used by commercial vessels traveling between northern Pacific ports (e.g., Seattle, San Francisco, and Vancouver) and those situated in Southern California, as well as by traffic using the Panama Canal or heading to and from western Pacific ports. The majority of oil tankers passing through the area voluntarily travel 93 km (50 nm) offshore (USCG 1997). However, those tankers heading south to the Port of Los Angeles use a route closer to shore. The USCG issues a Notice to Mariners (NOTMAR) that notifies passing vessels of the presence of activities in the area. Navy marine vessels for ocean-related activities also use Southern California waters. Common types of Navy vessels include range support boats, larger ships (cruisers, destroyers, and aircraft carriers), and surface targets.

3.7 SOCIOECONOMICS

3.7.1 Background

Socioeconomics describes the basic attributes and resources associated with the human environment, particularly population and economic activity. Economic activity typically encompasses employment, personal income, and industrial growth. Impacts on these fundamental socioeconomic components influence other issues such as housing availability and provision of public services.

The project area for socioeconomics is defined as the area in which the principal effects arising from implementation of the proposed action or an identified alternative are likely to occur. Due to the nature of the proposed action (i.e., a limited number of test personnel working at onshore and offshore locations, lack of large-scale construction activities, temporary nature of the testing, and the minimal amount of local material or manpower expenditures), the socioeconomic analysis focuses primarily on the commercial fishing and offshore recreational uses associated within the marine environment.

Executive Order 12898

In 1994, EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* was issued to focus the attention of federal agencies on human health and environmental conditions in minority and low-income communities, and to ensure that disproportionately high and adverse human health or environmental impacts on these communities were identified and addressed. This evaluation focused on the distribution of race and poverty status in areas potentially affected by implementation of proposed and alternative actions.

Executive Order 13045

EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, states that each federal agency:

"...shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children"; and
"...shall ensure its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks."

This EO, commonly referred to as "Environmental Justice for Children," focuses on the human health and environmental conditions in communities with children and ensures that federal activities do not disproportionately affect children.

3.7.2 PSS Ocean Test Location

3.7.2.1 Proposed PSS Ocean Test Location

Large-scale commercial fishing activities occur within territorial waters. All nearshore activities (i.e. less than 5.6 km [3 nm] from shore) are regulated by the State of California.

Commercial Shipping

Commercial shipping in Southern California is dominated by cargo transports, oil tankers, and barges. The region is used by commercial vessels traveling between northern Pacific ports (e.g., Vancouver, Seattle, and San Francisco) and those situated in Southern California. Vessels to and from the Panama Canal also transit the region and western Pacific ports. According to the USCG, oil tankers using the channel voluntarily travel 93 km (50 nm) offshore (USCG 1997).

Commercial Fishing

Southern California is an extremely productive commercial fishing area, especially the area including and within the Santa Barbara Channel and Channel Islands. Kelp beds extending from the mainland coast to the Channel Islands provide habitat for and access to many commercial species (e.g., urchins, abalone, lobster, squid, sardines, anchovies, mackerel, bonito, and rockfish). The CDFG regulates commercial fishing operations within state waters.

Catch totals and associated revenues for ports within the Santa Barbara area (which includes ports and landings from Los Angeles to Avila Beach), Los Angeles, and San Diego are recorded by the CDFG through required reporting procedures. Commercial fleets within each district report catch totals by species. A summary of reported poundage and values for these areas is presented in Table 3-5. A list of commercially fished species and their respective seasons is presented in Table 3-6. Commercial fisheries are discussed in greater detail in Section 3.6.

Table 3-5. Regional Commercial Fishing Poundage and Value (1995)

Port	Pounds	Value
Santa Barbara	134,084,000	$46,058,300
Los Angeles	170,111,000	$29,147,100
San Diego	4,092,050	$6,966,680
Total	**187,611,050**	**$82,172,080**

Source: CDFG 1996.

Table 3-6. Commercially Fished Species within Southern California

Species	Season
King salmon (chinook)	Regulated by federal Government
Silver salmon (coho)	Regulated by federal government
California halibut	Jun 16 - Mar 14
Surf perch	Jul 16 - Apr 30
Abalone[1]	Sep 1 - Dec 31; Mar 1 - Jul 31
Spiny lobster	1st Wed of Oct – 1st Wed after Mar 15
Clams	Sep 1 - Mar 31
Dungeness crab	Nov 15 - Jun 30
Shrimp (trawling)	Apr 1 - Oct 31
White sea bass	Jun 16 - Mar 14
Ridge back prawn (trawling)	Oct 1 - May 31
Spot prawn (trapping)	Apr 1 - Jan 15
Sea urchin	Seasons vary 2

Source: CDFG 1996.
[1]As of May 1997, the CDFG has placed a temporary closure on all commercial abalone harvesting.
[2]Sea urchin seasons are:

Nov 1 - Mar 31: 7 days per week
Apr and Oct: Mon-Thu
May and Sep: Mon-Thu (closed 2nd week)
Jun and Aug: Mon-Wed (closed 2nd week)
Jul: closed north of San Luis Obispo/Monterey County Line but open Mon-Thu except 2nd week south of county line

Sport Fishing

Southern California is the leading recreational fishing area along the Pacific coast of the U.S.; the region is fished year-round due to favorable weather and sea conditions. Recreational fishing is commonly done from shore, private boats, and charter boats.

Inner waters from the U.S.-Mexico border to Point Conception are lined with kelp beds and reefs that provide recreational fishing opportunities to catch kelp bass, yellowtail, bonito, rockfish, barracuda, and others. Popular Channel Islands sport fishing areas are concentrated around the offshore kelp beds and open ocean south of the Anacapa and Santa Cruz islands (California Coastal Commission [CCC] 1993). Total fish catches of recreational passenger fishing boats in California are recorded by the CDFG (Table 3-7). Recreational fishing is discussed in greater detail in Section 3.6.

Table 3-7. Fish Caught by California Recreational Passenger Fishing Fleets (1990 and 1991)

Species	1990 Totals (# fish)	1991 Totals (# fish)
Rockfish	311,992	339,025
Bass (various)	165,375	165,225
Mackerel (Pacific and jack)	40,844	57,999
Whitefish	19,288	26,435
California barracuda	16,429	25,109
Halfmoon	4,853	17,269
Sheephead	7,344	12,201
Sculpin	9,030	9,771
Lingcod	4,844	7,644
Flatfish	1 ,948	1,780
Cabezon	1,374	1,134
California halibut	842	811
Others	476	650
Salmon	3	404
White sea bass	1,248	302
Pacific bonito	10,377	251
Sanddab	17	205
White croaker	278	140
Opaleye	23	89
Sole	15	50
Sablefish	183	20
Yellowtail	1,000	16
Jacksmelt	80	10
Tuna	0	7
Total Fish	**597,863**	**666,548**
Total Anglers	**67,698**	**73,988**
Total Boats	**31**	**29**

Source: CCC 1993.

Other Recreational Activities/Tourism

The public also uses the area of the proposed ocean test location for other recreational activities, such as sport fishing, boating, diving, and whale watching. These activities originate from harbors, coves, and marinas along the mainland coast. Whale watching is popular in the region primarily from March through May (during the annual gray whale northward migration); bird watching and marine mammal observation are popular year-round. Recreational diving at shipwrecks and natural areas around the Channel Islands is also popular (CCC 1993).

Environmental Justice/Children's Justice

No permanent population centers exist within areas encompassed by the proposed ocean test location. Military and National Park Service support facilities on San Nicolas, Santa Cruz, and San Miguel islands are staffed by civilian and Navy personnel on temporary assignments who are not recorded as residents during census counts. There are no data pertinent to the ethnicity or income of persons temporarily residing on the islands; however, given the small number of potentially affected individuals, their temporary residential status, and the fact that the majority of them are employed by the federal government, it is unlikely that affected persons would be low income or otherwise disproportionately susceptible to adverse socioeconomic or environmental impacts. There are no schools located adjacent to or in the vicinity of the proposed ocean test location

3.8 NOISE

Noise is defined as undesirable or unwanted sound. Noise exposure can occur in two general media: air and water. The following discussion focuses on noise sources, sound transmission characteristics in these media, and background (ambient) noise. Ambient noise sources are an important parameter because they can mask other sounds (i.e., make them less detectable) as they propagate away from the source of disturbance. Typically, ambient noise is produced by a number of sources. In the ocean, geological, oceanographic, and meteorological processes such as earthquakes, volcanoes, wind, rain, waves, swells, and surf produce ambient noise. Various marine organisms and marine mammals also produce noise. Man-made noise is produced by a number of sources such as motorized vessels, sonar and seismic, and oil explorations.

3.8.1 Background

<u>Noise Terminology</u>

Sound is composed of waves of energy that travel through air or water as vibrations of fluid particles. The rate at which the vibrations occur is referred to as sound frequency, and is measured in cycles per second or hertz (Hz). Sound exists in the environment even though it may not be audible to a given receptor; for example, humans cannot detect sounds below a frequency of 20 Hz or above a frequency of 20,000 Hz (or 20 kHz).

Acoustic intensity measures the transmission of acoustic energy per unit area per unit time. Intensity is a useful measure for tonal or continuous sounds. The intensity of sound is expressed in decibels and is measured on a logarithmic scale; on the decibel scale, an increase of 10 units represents a 10-fold increase in sound intensity. The decibel scale is a relative measure and, therefore, intensities expressed in decibels are ratios of the sound intensity to a reference intensity. Because acoustic sensors commonly measure acoustic pressure rather than directly measuring intensity, reference is often made to an acoustic pressure, with the corresponding acoustic intensities being proportional to the square of the pressure.

Accordingly, sound studies commonly acknowledge the "reference pressure" of a given sound. For example, the conventional reference pressure for airborne sounds is 20 μPa and the sound level is described in terms of dB re 20 μPa (decibels relative to a root mean square pressure of 20 micropascals). Alternatively, underwater sounds are referenced to 1 μPa, and described in terms of dB re 1 μPa.

Comparisons of acoustic intensities in air and water involve two different corrections. The first is the difference in commonly used reference pressures mentioned above, which leads to a difference of 26 dB. The other arises from the different acoustic impedances of air and water. When comparing sounds which transmit the same acoustic energy per unit time (same intensities), the correction for the difference in acoustic impedances between air and water leads to a further 36 dB of difference, for a total of 62 dB. That is, a 162 dB re 1 μPa sound in water transmits as much energy per unit area per unit time as a 100 dB re 20 μPa sound in air.

The foregoing discussion applies to continuous or tonal sounds. For short duration or pulsed sounds such as the PSS source, a more appropriate metric for impulsive underwater sounds is the total energy per unit area in the pulse (time integral of the intensity), (Richardson, 1995). This energy ratio is commonly described in terms of dB re 1 μPa^2-sec.

The distinction made between airborne noise and underwater noise is based upon the very different sound propagation characteristics of the two media. In general, sound is transmitted much more efficiently in water than in air. This is due primarily to the higher density of water over air and the substantially lower absorption capacity of water molecules over their air counterparts. Sources of noise in either of these acoustical environments may be natural (e.g., wind, waves, biological organisms, etc.).

Airborne Noise Characteristics

Airborne noise in offshore areas typically consists of ambient noise levels from natural and man-made sources. Airborne sound decreases with magnitude as it moves away from the noise source due to spreading and absorption losses. These sound decreases are primarily dependent on the types of interaction surfaces (e.g., water, sand, and vegetation) and on atmospheric conditions (e.g., temperature inversions, wind speed and direction, and relative humidity). A common source of airborne noise in offshore areas is marine vessels. Noise sources associated with marine vessels include engine noise, intake and exhaust noise, auxiliary equipment such as pumps and winches, and onboard public address systems.

Underwater Noise Characteristics

Underwater Noise Propagation

Sound in water propagates more efficiently than sound in air but is subject to similar types of transmission loss (TL) (e.g., spherical spreading and attenuation). When sound spreads spherically, sound intensity from the source diminishes as the square of the distance from the source ($1/r^2$ or 6 dB per range doubling) where r = range. This is based on the accepted approximation for transmission loss: TL = 20 Log r (Kinsler and Frey 1982). In the underwater environment, sound typically spreads spherically from the sound source until it is reflected by a surface, such as the ocean bottom or a submerged object, and multiple propagation paths are established. Sound can also reflect off various surfaces in the underwater environment resulting in cylindrical spreading (1/r or 3 dB per range doubling). Transmission loss associated with cylindrical spreading is less than that for spherical spreading; however, due to absorption, sound intensity attenuates at the same rate no matter what the distance from the sound source.

Reflections at the water-air boundary result in minimal sound loss. Noise levels resulting from reflections at the ocean bottom depend on the composition of the bottom (i.e., material properties) and the angle with which the wave strikes the surface (i.e., angle of incidence). Under hard bottom conditions, reflection losses are low and, as the direct and reflected sound paths combine, cylindrical spreading occurs. Typically, underwater sound attenuation in shallow ocean environments is described by a combination of spherical and cylindrical spreading. In general, transmission loss is less in shallow-water environments because the onset of cylindrical spreading occurs at much shorter ranges.

For the PSS test, estimates based on these simple models of acoustic propagation have been compared with the results of sophisticated range dependent parabolic equation models of underwater acoustic propagation. The results of the two methods were found to agree within the limits of accuracy of the models for the short ranges to which sound loud enough to be of concern will propagate.

Underwater Ambient Noise Conditions

Underwater ambient noise can have several sources. Naturally occurring wind and waves at the ocean surface (the primary source) can cause noise; biological noise from marine mammals, snapping shrimp, and fish; and subsurface geologic events such as earthquakes and magma movement can all cause noise. Table 3-8 provides a list of typical natural underwater noise sources and their associated levels.

Table 3-8. Typical Natural Underwater Noise Sources and Levels

Noise Source	Noise Level (dB)
Wind and waves	85
Earthquake/magma movement (impulsive noise)	95-135
Bottlenose dolphin	125-173
Humpback whale call	175
Gray whale call	185
Killer whale call	160

Source: Scripps Institution of Oceanography (Scripps) 1997b.

Man-made ocean noise has increased steadily since the beginning of the industrial age. The predominant source of noise is from shipping traffic and underwater exploration. Most of these sounds are low frequency in nature (i.e., less than 250 Hz) and can travel considerable distances. Typical man-made underwater noise sources and their associated levels are shown in Table 3-9.

Table 3-9. Typical Man-Made Underwater Noise Sources and Levels

Noise Source	Noise Level (dB)	Noise Characteristics
Large tanker	177	A continuous noise on shipping pathways worldwide
Icebreaker	183	A cycling noise primarily in Arctic Ocean, north of Canada, Alaska, and Russia
Low frequency sonar	200+	Continuous pulses at undisclosed locations, potentially worldwide
Supply ship	174	Continuous sound emitted along shipping lanes worldwide
Seismic oil exploration	259	Low-pitched pulses of impulsive sound, generated in oil-rich ocean areas worldwide
Dredging boat	167	Continuous, low frequency grinding, in nearshore construction areas

Source: Scripps 1997b.

3.8.2 PSS Ocean Test Locations

3.8.2.1 Proposed PSS Ocean Test Location

Ambient Noise

The proposed PSS ocean test site would be located within the marine environment of Southern California (refer to Figure 2-5). Sea state conditions are a large natural contributor to ambient noise (Wenz 1962). Sea state conditions in this area can be classified as moderate. The fetch (or area of water over which wind waves can be generated) is relatively large for most wind directions (over 34,000 km^2 [10,000 nm^2]) and thus wave heights can be large. Sea states can easily exceed 4 on the Beaufort International Scale (moderate breeze between 11-16 knots, wave height 3-6 ft). Another predominant source of ambient noise is attributed to distant vessels, primarily commercial shipping and fishing vessels, recreational fishing boats, and smaller commercial craft. These two general noise sources (wind/waves and vessel traffic) comprise the major constituents of ambient noise.

Exact ambient noise levels for the proposed ocean test location were not available; however, ambient underwater noise conditions within Southern California are predominately associated with distant commercial and recreational vessel traffic and wind action. In addition, military activities within this area slightly contribute to ambient noise conditions. Based upon previous studies (Wenz 1962), ambient noise levels for the proposed ocean test location can be expected to range between 60 and 70 dB at higher frequencies (above 1,000 Hz) and between 85 and 95 dB at lower frequencies (below 100 Hz). Sound emissions at or below 100 Hz are predominately from vessel traffic, while those above 400 Hz are primarily from wind and waves. Levels above 100 dB are typically due to man-made activities; the relative intensity is an indicator of the source loudness.

For military activities within the proposed PSS ocean test site area, the primary underwater transient sound sources for military operations include ships' sonars, torpedo and missile launches, and water surface impacts from missiles and falling debris. The area offshore from MCB Camp Pendleton is frequently used for Naval training exercises utilizing surface ships and amphibious landing craft. Under heavy test conditions, ambient levels can exceed 175 dB (in the low frequency bands) in localized areas near training operations offshore from MCB Camp Pendleton (USMC) 1995.

Transmission Loss

Although the bathymetry of Southern California is topographically complex, the ocean bottom where the proposed ocean tests would occur would be characteristic of soft bottom conditions and consist primarily of silts and clays. Underwater noise in this type of environment would experience primarily spherical spreading loss.

3.9 CULTURAL RESOURCES

3.9.1 Background

Cultural resources represent and document activities, accomplishments, and traditions of previous civilizations and link current and former inhabitants of an area. Depending on their condition and historic use, these resources may provide insight to living conditions in previous civilizations and may retain cultural and religious significance to modem groups.

Archaeological resources comprise areas where prehistoric or historic activities measurably altered the earth or produced deposits of physical remains (i.e., arrowheads, bottles) discovered therein. Architectural resources include standing buildings, districts, bridges, dams, and other structures of historic or aesthetic significance and generally must be more than 50 years old to be included in the National Register of Historic Places (NRHP), an inventory of culturally significant resources identified in the United States. More recent structures, such as Cold War era resources, may warrant protection if they have the potential to gain significance in the future. Traditional cultural resources can include archaeological resources, structures, neighborhoods, prominent topographic features, habitats, plants, animals, and minerals that Native Americans or other groups consider essential in the persistence of traditional culture.

Under federal laws and regulations, only significant cultural resources warrant consideration with regard to adverse impacts resulting from federal activities. Significant archaeological and architectural resources include those that are eligible or are recommended as eligible for inclusion in the NRHP. The significance of cultural resources is evaluated according to the NRHP eligibility criteria (36 CFR 60.4), in consultation with the State Historic Preservation Office (SHPO) and Advisory Council on Historic Preservation. According to these criteria, "significance" is present in districts, sites, buildings, structures, and objects that:

(a) are associated with events that have made a significant contribution to the broad patterns of history; or
(b) are associated with the lives of persons significant in the past; or
(c) embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, possess high artistic value or represent a significant and distinguishable entity whose components may lack individual distinction; or
(d) have yielded, or may be likely to yield, information important in prehistory or history.

There are no legally established criteria for assessing the importance of a traditional cultural resource. These criteria must be established primarily through consultation with Native Americans, according to the requirements of the Native American Graves Protection and Repatriation Act. When applicable, consultation with other affected groups provides the means to establish the importance of their traditional resources. They may also be derived from 36 CFR 60.4 and from the Advisory Council on Historic Preservation guidelines.

Research Methodology

The project area for cultural resources includes only an ocean test location site. For the ocean test location, cultural resource issues are primarily related to potential impacts on underwater archaeological resources. Refer to Figure 2-5 for a depiction of the proposed ocean test location.

The methodology for determining the presence of significant cultural resources within the project area was based on a combination of existing data, literature searches, and site inspections conducted in support of the Advanced Deployable System (ADS) EA which occurred over an area encompassing the PSS test site. Specific databases on known under-water cultural resources were searched to analyze the potential for the proposed ocean test locations to contain submerged cultural resources. Literature searches were performed at the South Coastal Information Center and Museum of Man in San Diego, California. Information was collected on existing cultural resources surveys in the area.

3.9.1.1 Regional Southern California History

Offshore

There are no offshore islands within the proposed ocean test location. Archaeological evidence indicates that prehistoric populations were traversing the waters off the coast of Southern California possibly as early as over 10,000 years ago. The presence of archaeological sites dating from 12,000-8,000 years before present (B.P.) on Santa Rosa, San Miguel, Santa Cruz, and San Clemente islands indicate that some type of watercraft was used to travel from the mainland to the outer islands. The coastal Chumash visited the Channel Islands in a variety of watercraft, (i.e., plank canoes [tomols], reed rafts or tule balsas, and dugout canoes). Later evidence shows the other islands (e.g., Santa Catalina and San Clemente) were frequented by the Gabrielenos. Bad weather and swift currents most likely contributed to the failure of many of these voyages, subsequently depositing heavy artifacts, such as stone bowls and mortars, on the sea floor, although precise records indicating the locations of undersea prehistoric artifacts are lacking.

Onshore

Prehistorically, the earliest period recorded for human occupation in the Southern California region dates from 12,000-8,000 years B.P. and is typified by artifact assemblages, termed the San Dieguito complex, extending from Oregon to mid-Baja California. Subsequent to the San Dieguito, the Middle Archaic Period (La Jolla complex) lasted at least 7,000 years, possibly beginning as early as 8,000-9,000 years ago. Occupation was heaviest along the coast and major drainage systems extending inland. Middle Archaic Period sites situated in the inland area of northern San Diego County, termed the Pauma complex, are usually located on small saddles and low hills overlooking drainages.

Following the Middle/Archaic Ages, around 1,500 B.P., Shoshonean-speaking people from the Great Basin area are believed to have begun migrating into Southern California, including the northern area of San Diego County. Inland semi-sedentary villages were established along major watercourses, and mountain areas were seasonally occupied to exploit acorns and pinon nuts. The San Luis Rey complex in northern San Diego County, which includes MCB Camp Pendleton, represents this period called the Late Prehistoric Period. The San Luis Rey complex is considered to represent the Shoshonean predecessors of the ethnohistoric Luiseno.

Historically, the Spanish explorer, Gaspar De Portola on his journey up the coast with Padre Junipero Serra to establish a chain of missions in 1769, first visited the area known today as MCB Camp Pendleton. The El Camino Real, or King's Highway, traversed the MCB Camp Pendleton area along the coast and served as the main corridor for all travel in the coastal region.

After the establishment of the missions, the MCB Camp Pendleton area and the Native Americans living on it came under the jurisdiction of Mission San Luis Rey. The MCB Camp Pendleton area became part of a large grant of land that included Rancho Santa Margarita and the Las Flores mission outpost. The land grant totaled 133,400 acres (54,000 ha) and included 56 km (35 miles) of coastline, seven rivers and streams, seven small lakes, and three mountain ranges. MCB Camp Pendleton comprises a part of the original rancho lands.

In 1931, land was leased from the owners by the U.S. government, at which time an emergency landing airstrip with beacon lights was established (Pourade 1975; Sully and Begelow 1988). In 1941, the U.S. government purchased 9,000 acres (3,600 ha) of the former rancho to establish the Naval Ammunition

Depot. In 1942, shortly after the Japanese attack on Pearl Harbor, the remaining rancho land was purchased by the U.S. Navy for use as its major West Coast training base.

3.9.2 PSS Ocean Test Location

3.9.2.1 Proposed PSS Ocean Test Location

Archaeological resources within Southern California waters are limited to shipwrecks and occasional isolated artifacts that were lost from Native American watercraft during prehistoric or historic voyages. More than 500 sunken vessels have been reported within the coastal waters of Southern California. Precise locations are infrequently provided, with vague descriptive narratives of the area in which the ship was last known, or thought to have sunk. Generally, topography, weather conditions (e.g., high wind, dense fog), geographical features (e.g., submerged rocks or reefs), and human error are all factors that may influence vessel failures.

Although existing information on submerged cultural resources is limited, a shipwreck study was recently performed that combined several existing databases for known shipwrecks within the Southern California coast. The study also developed a predictive model to determine areas most likely to contain shipwrecks. Information from this study was utilized to document known shipwreck locations and postulate areas where shipwrecks are likely to occur (DoN 1998b). There are various explanations for their fates, such as mechanical failures, fires, collisions, or capsizing. The most concentrated locations of shipwrecks are along headlands and harbor approaches and in inner harbor waters on the main coastline and the offshore islands. It is estimated that that between 80 and 90 percent of all vessel losses in the region occurred in less than 10 m (33 ft) of water (Morris and Lima 1996).

3.10 SAFETY AND ENVIRONMENTAL HEALTH

3.10.1 Background

For the purposes of this EA, safety and environmental health issues are defined as those that directly affect the continued ability to protect and preserve life and property within the areas proposed for testing of the PSS system. Issues associated with implementation of the PSS system include public safety, which addresses the potential exposure of public citizens to unsafe conditions. Since the proposed action involves activities on the ocean and in coastal areas, safety issues focus on public access to the proposed test sites and potential interaction with system components. Examples of safety and environmental health issues include conflicts with recreational and commercial users of the ocean environment (e.g., divers), as well as exposure of these users to electromagnetic field (EMF) radiation generated by electrical signals associated with electronic or communication equipment. The American National Standards Institute (ANSI) has established safety thresholds for exposure of humans to EMF at various frequencies (ANSI 1991).

3.10.2 PSS Ocean Test Location

3.10.2.1 Proposed PSS Ocean Test Location

Commercial, military, and recreational vessels commonly transit within territorial waters (refer to Figure 2-5). Although large ships remain in shipping lanes, no restrictions exist for smaller vessels. Public safety issues are related to heavy boating and shipping activity, as well as commercial and Navy ocean testing operations that occur throughout the Southern California marine environment. In addition, the SCB is popular for recreational activities. Common offshore recreational activities include boating, sport fishing, scuba diving, sailing, and kayaking. However, these types of activities are typically conducted with sufficient separation from areas of heavy public use.